CALFED Bay-Delta Program

Ecosystem Restoration Program

Stage 1A Actions

General Descriptions of Stage 1A Bundles

Lower San Joaquin River and South Delta Region Bundle

This bundle is designed to address water management and fisheries concerns in the south Delta and lower San Joaquin River region, for local water uses as well as State and federal exporters. Specific issues to be addressed include fisheries, water quality, water supply reliability, recreation, flood control, and wildlife habitat. The preliminary actions are designed to advance feasibility and environmental evaluations and to implement corrective actions in the south Delta region as well as in upstream watersheds which affect the quality and quantity of flows in the San Joaquin River. It is also designed to address some of the scientific uncertainties related restoration of processes, habitats, and species in this geographic area.

Lower Sacramento River, Yolo Bypass, and North Delta Bundle

This bundle is designed to develop a balanced solution to concerns surrounding fishery and water quality impacts of diversions from the Sacramento River into the central Delta, to address regional flood concerns, and to substantially enhance riparian and wetlands habitat corridors in the region. Because of the concern over toxicity effects of mercury originating in the Cache Creek basin, this bundle includes substantial research to identify those sources and potential remediation tools.

Suisun Marsh and West Delta Bundle

This bundle is designed to address water quality, fisheries protection, and habitat enhancement actions for the west Delta region, including Suisun Marsh and the west Delta islands.

Delta-Wide ERP/Levees Bundle

This bundle is designed to achieve a reasonable balance between implementation of ecosystem improvement actions and levee system improvement actions. In addition this bundle includes actions to improve fisheries, water quality, and habitat throughout the Delta, including protection and enhancement of Delta in-channel islands.

Sacramento River, San Joaquin River, and Tributaries Bundle

This bundle includes ecosystem restoration primarily fisheries habitat, hatchery management, and floodplain and meander belt restoration along key river reaches.

Integrated Water Management Bundle

This bundle includes actions which can lead to improvements in water supply reliability and flexibility through improvements in water use efficiency, water transfers, water storage and conveyance facilities (groundwater and surface water), water quality, and water associated habitats. The proposed actions include the Program problem area and solution areas, including state and federal project service areas and upper watersheds. It includes key actions that comprise the Integrated Storage Investigation and implementation of the Environmental Water Account.

Ecosystem Restoration Program Actions in Stage 1A Bundles

Lower San Joaquin River and South Delta Region Bundle

Special emphasis is placed on the actions which comprise the lower San Joaquin River and South Delta region bundle. The Ecosystem Restoration Program emphasis is on the creation and maintenance of a living river corridor that sustains natural ecological processes and supports sustainable habitats needed by aquatic and terrestrial species, on the creation of fresh emergent wetland and riparian and riverine aquatic habitats in the Southern Delta and evaluations to determine if such habitats provide sufficient ecological benefits to warrant the creation of additional fresh emergent wetland habitats, and on the evaluation of the cumulative impact of small unscreened diversions in the South Delta.

The CALFED Bay-Delta Program approach for the lower San Joaquin River and South Delta region is to implement integrated projects and programs that will either make a substantial contributions to the overall ecological health of the region or provide answers to critical ecological uncertainties, thus providing more precise direction for future action bundles.

San Joaquin River Floodplain Corridor. The San Joaquin River and its tributaries once supplied the bulk of nutrients and sediments to the Delta. The principal flow of the San Joaquin River overflowed its channel and moved on to the vast floodplain of the San Joaquin Valley. Nutrients to support the Delta foodweb and sediment to build habitats were transported to the Delta. These ecological processes seldom occur now. Water development and flood management have substantially reduced overbank flooding along the San Joaquin River.

The approach for the San Joaquin floodplain corridor it to integrate ecosystem restoration actions with flood damage reduction by establishing or improving floodplain interactions along the San Joaquin River and its tributaries. Flow or flowage easements would be acquired and agricultural production would continue, but instead of building flood levees or storage facilities, land owners would be compensated for allowing their land to flood. In this manner, a surrogate for the natural floodplain process could be established.

CALFED will evaluate proposed projects using the following types of criteria:

- Contribute to the restoration of San Joaquin River floodplain habitat within the Delta,
- Provide seasonally inundated habitat such as flood bypasses
- Acquisition of flood plain through conservation easements or direct purchase
- Provide an opportunity to develop and implement the project as an adaptive intervention complete with conceptual models, testable hypotheses, and comprehensive monitoring.

Creation and Evaluation of the Ecological Benefits of Fresh Emergent Wetland Habitat in the South Delta. Entrainment of native fish species at the State and Federal Delta pumping facilities is a significant problem that may be abated by a variety of actions including a consolidated point of diversion, new fish screens at the point of diversion, use of water through

the Environmental Water Account to allow reduced diversions at critical stages to protect native fishes, and enlarged channel capacities to reduce flow velocities toward the Delta diversion facilities.

A significant ecological uncertainty is associated with the role and value of fresh emergent wetland habitat in the South Delta in providing forage, rearing and protective habitats and in reducing the probability that fish will be entrained. Emergent wetland habitat areas will be designed and recreated in the South Delta as an adaptive experiment using all available tools including conceptual models, hypothesis testing, and comprehensive monitoring.

CALFED will evaluate proposed projects using the following types of criteria:

- Create or maintain tidally influenced fresh emergent wetland habitats along major conveyance routes to the Delta pumping facilities
- Provide an opportunity to develop the project as an adaptive experiment including conceptual models, testable hypotheses, and comprehensive monitoring.
- Contribute to resolution of some of the ecological uncertainties related to re-creation tidally influenced wetlands in the Delta.

Ecosystem Restoration Program Levee Setback Feasibility Study. A major component of the Ecosystem Restoration Program Plan is the re-creation of shallow, tidally influenced aquatic habitat in the Delta. This restoration objective could be accomplished by purchase and flooding of agricultural land, the deposition of fill or setting back of levees. The large-scale flooding of agricultural land can cause regional economic and social impacts. The deposition of fill can cause environmental impacts, navigation impacts and impacts to flood management and water transport.

The approach is to implement actions and studies that will resolve the ecological and technical uncertainties associated with levee setback actions to create tidally influenced shallow water habitats. Resolution in needed early in the program so that the long-term effort can be refined based on improved scientific information. Resolution will be achieved by geotechnical and engineering analyses to establish feasibility and estimated costs associated with levee realignments.

CALFED will evaluate proposed projects using the following types of criteria:

- Feasibility of creating or maintaining fresh emergent wetland and riparian and riverine aquatic habitats through levee setbacks or fill of deep water areas
- Can be evaluated as an adaptive experiment
- Help resolve some of the ecological uncertainty related to environmental benefits anticipated from such actions.

Evaluate the Need to Screen Small Diversions on the South Delta. There are a large number of relatively small diversions diverting water from the South Delta. These smaller diversions have the potential to entrain juvenile fish, but there is relatively little data that can be used to identify where the biological benefits would be of the greatest benefit in a program to

screen smaller diversions. Evaluations of alternative methods of preventing entrainment at larger diversions have not identified any effective solutions other than positive barrier fish screens. However, when evaluating screening at smaller diversions less that 25 cfs, there may be other techniques for preventing entrainment that could be cost effective in some situations.

Unlike the riverine environment where unscreened diversions may affect a large portion of fish populations, the benefits of screening small diversions in the South Delta is unknown. An evaluation should be undertaken to identify diversion effects on species and locations in the Delta and to identify locations where screening small diversions would be a high priority.

Two general topics are recommended for evaluation: synthesis of existing information on entrainment in the Delta at small diversions and evaluation of entrainment effects at actual diversions if willing landowners can be identified.

The approach is to determine the biological benefits of screening small diversions in a tidal environment and the technical feasibility of doing so. CALFED will evaluate proposed projects using the following types of criteria:

- Contribute to better understanding of the ecological uncertainty related to small unscreened diversions in the South Delta
- Consolidate existing information regarding the loss of native fish in small unscreened diversions
- Consolidate existing information regarding methods or techniques to install and operate screens on small diversions in the South Delta.

Lower Sacramento River, Yolo Bypass, and North Delta Bundle

Special emphasis is also placed on the actions which comprise the lower Sacramento River, Yolo Bypass and North Delta region bundle. The Ecosystem Restoration Program emphasis is on the creation and maintenance of a sustainable aquatic and riparian and riverine aquatic habitats needed by aquatic and terrestrial species, on the creation of fresh emergent and seasonal wetland and habitats linked to flood control activities in the North Delta and Mokelumne River corridors and evaluating additional fresh emergent wetland habitats.

The CALFED Bay-Delta Program approach for the lower Sacramento River, Yolo Bypass, and North Delta region is to implement integrated projects and programs that will either make a substantial contributions to the overall ecological health of the region or provide answers to critical ecological uncertainties, thus providing more precise direction for future action bundles.

Restore Tidal Habitats along Georgiana Slough. Georgiana Slough is a natural distributary of the Sacramento River. It carries Sacramento River water to the interior of the Delta. When state and federal water project exports are high, unnaturally high volumes of Sacramento River water are drawn into the interior of the Delta. This highly modified hydrologic action exposes young fish of Sacramento River origin to high rates of predation and entrainment loss. The loss of escape cover and other aquatic habitats along Georgiana Slough exacerbates the

problem. The absence of habitat has been attributed to levee construction, boat wakes and increased flow velocities entering the Central Delta through Georgiana Slough.

The approach is to create a mosaic of riparian and riverine aquatic and tidally influenced fresh emergent wetland habitats along Georgiana Slough to provide direct benefits to fish species rearing or migration through the slough. The restoration actions will be designed and implemented as adaptive experiments complete with comprehensive monitoring for the dual purposes of helping to restore listed species while resolving some of the ecological uncertainty linked to the role of riparian and riverine aquatic and fresh emergent wetland habitats in the survival of young fish.

CALFED will evaluate proposed projects using the following types of criteria:

- Preliminary or technical feasibility studies that identify potential sites for restoration experiments
- Feasibility studies of creating or maintaining shallow water and riparian habitats through setback levees
- Monitoring or research programs that can provide critical information needed to resolve the ecological uncertainty related to the role and value of riparian and riverine aquatic and fresh emergent wetland habitats along Georgiana Slough.

Integrate Ecosystem and Flood Control Improvements in the Lower Mokelumne River. The Mokelumne River corridor is one of four major habitat corridors proposed in the Ecosystem Restoration Program Plan for the Sacramento-San Joaquin Delta Ecological Management Zone. Acquisition of land for future conversion to a variety of aquatic habitats are the major focus of recently completed actions in the area. These actions are closely allied with programs and projects identified in the Long-Term Levee Protection Plan. Together, actions from these two common programs can provide significant ecological benefits including increased riparian and riverine aquatic habitats, ecologically beneficial floodplain configurations, and improved habitats for fish spawning, rearing, and migration.

The approach is to implement adaptive experiments designed to contribute to the restoration of listed fish species, improve habitat for a wide variety of other aquatic and terrestrial species, improve river-floodplain interactions and flood protection by setting back levees, and resolve ecological uncertainty by implementing a comprehensive monitoring and research program.

CALFED will evaluate proposed project using the following types of criteria:

- Opportunity to convert land to a variety of riparian and riverine aquatic habitats and tidally influenced fresh emergent wetland and tidal perennial aquatic (open water) habitats while providing improved flood protection in the form of wider floodplains and setback levees
- Opportunity to create new habitats as adaptive experiments complete with conceptual models, hypotheses, and comprehensive monitoring

Provide Needs And Opportunities Analysis For Improving Ecosystem Restoration And Flood Bypass Habitat In The Yolo Bypass Area. Recent investigations indicate that

the Yolo Bypass acts as a surrogate or alternative for floodplain habitat. When the bypass is operating, it effectively doubles the floodplain habitat of the Bay-Delta system. Field studies have demonstrated that the bypass supports at least 40 species of fish including delta smelt, steelhead trout, sturgeon, and chinook salmon including spring-run and winter-run chinook. The bypass appears to be particularly valuable habitat for the Sacramento splittail. It is hypothesized that the seasonal nature of the habitat serves the needs of native species and can provide a competitive advantage over non-native introduced species.

The bypass also appears to be an important link in the estuarine food chain. During periods of high flows, the bypass is a primary pathway for organic carbon to the estuary, a pathway that does not affect drinking water supplies.

The goal of the project is to complete an analysis of alternative way to increase the frequency and duration of Yolo Bypass flooding while maintaining agricultural production and without encroaching on flood capacity.

The approach is to design and implement a series of adaptive experiments to expand or enhance seasonal shallow-water habitats in the Yolo Bypass and near Delta floodplain. Habitat creation in the Yolo Bypass presents one of the best opportunities for ecosystem restoration because large areas of habitat can probably be created at small cost while retaining the flood management functions of the bypasses.

CALFED will evaluate proposed projects using the following types of criteria:

- Projects that do not encroach on the flood flow capacity of the bypass
- Projects that have local government, agricultural, stakeholder, and agency support
- Projects that provide adaptive interventions and are information rich
- Projects that demonstrate a robust monitoring program required by adaptive management

Cache Creek Mercury Source Control. Mercury-bearing ores are found throughout the upper Cache Creek watershed. These ore deposits are associated with geothermal springs and historic mines, both of which provide pathways for mercury to enter Cache Creek. Organic forms of mercury (including methylmercury) can be easily taken up into the food chain by aquatic insects. Mercury is monitored in the basin by Yolo County, Regional Water Quality Control Board, U.S. Geological Survey, and the U.S. Fish and Wildlife Service.

Monitoring in 1997 indicated that highly elevated mercury levels were present in several sub-drainages between Clear Lake and Rumsey. For example, Harley Gulch, Davis Creek and Bear Creek exhibited high mercury levels, presumably form known mercury mine sites or a stream draining a mercury mining zone.

The approach is to collaborate with ongoing investigations and the County of Yolo to identify known mercury contamination sources that could be subject to remediation through adaptive intervention. This effort would be consistent with the Cache Creek Resources Management Plan and the Cache Creek Improvement Program.

CALFED will evaluate proposed projects using the following types of criteria:

- Projects that are consistent with local resource plans for Cache Creek
- Projects that will provide information through adaptive experimentation and monitoring
- Projects that focus on mercury "hot spots" in the Cache Creek drainage.

Suisun Marsh and West Delta Bundle

The ecological and geographic regions encompassed in the Suisun Marsh and West Delta bundle include numerous areas of critical importance to listed fish, plant, and wildlife species. Restoration actions within this large area are designed to complement actions developed within other CALFED common programs and have strong links to programs and projects prepared by other state, federal and local agencies.

The CALFED Bay-Delta Program approach for the Suisun Marsh and West Delta bundle is to implement a well-integrated group of projects that will either make substantial contributions to the restoration of listed species, contribute to the overall ecological health of the regions, or provide answers to critical ecological uncertainties and, thus, provide guidance for the development and implementation of future restoration actions.

Implement a Suisun Marsh Diversion Screening Program. There are a large number or relatively small diversions diverting water from the Suisun Marsh and the Delta. These smaller diversions have the potential to entrain juvenile fish, but relatively little data exist that can be used to identify where the biological benefits would be the greatest in a program to screen smaller diversions. Evaluations of alternative methods of preventing entrainment at larger diversions have not identified any effective solutions other and positive barrier fish screens. However, when evaluating screening at smaller diversions under 25 cfs, there may be other techniques for reducing or preventing entrainment that could be cost effective in some situations.

A serious conflict exists in the Suisun Marsh between the potential for listed fish species to be entrained and the need to divert water for managed wetlands. There is also some uncertainty related to the relative ecological benefits of screening Suisun Marsh diversions relative to the magnitude of diversions in other areas. One goal of this effort is to establish the scientific basis for a screening program in the Suisun Marsh and to establish priorities for installing screens.

The approach is to eliminate the ecological uncertainty of screening diversions in the Suisun Marsh by implementing a comprehensive program to identify screening opportunities, create collaborative efforts with local landowners and the Suisun Resource Conservation District, to develop adaptive experiments to better understand the magnitude of the problem, and to develop a long-term program to abate the problem.

CALFED will evaluate proposed projects using the following types of criteria:

- Preliminary or technical feasibility studies to identify potential sites for pre-project evaluation
- Implementation projects to install, operate and evaluate experimental or innovative screen designs

- Comprehensive evaluations of screening needs
- Monitoring and research programs designed to provide information to resolve ecological uncertainty regarding the need for screening diversions in the Suisun Marsh.

Evaluate and Restore Tidal Wetlands in Suisun Marsh and Van Sickle Island. Suisun Marsh is the largest remaining brackish water marsh in California. It is an extremely important area for migrating waterfowl, shore birds, and wading birds. It provides important habitats for listed aquatic species such as delta smelt and chinook salmon. The marsh also harbors several listed plant species and mammal species. Restoration and protection of these diverse species is closely centered on restoration of tidal marsh habitats and adjacent wetland, upland and riparian habitats.

The approach is to develop and implement a collaborative program to restore saline emergent wetland, tidal perennial aquatic, perennial grassland, and riparian and riverine aquatic habitats in a manner compatible with a "whole marsh concept" in which tidal marshes are well connected to adjacent wetland habitats, upland habitats, and riparian systems. The approach also is to implement marsh restoration in a manner that contributes to levee system reliability by relocating vulnerable levees or implementing habitat restoration actions in conjunction with levee reconstruction.

CALFED will evaluate proposed projects using the following types of criteria:
- Acquire land through conservation easement or purchase
- Complete technical analyses that lead to proposed restoration actions
- Design monitoring programs for adaptive experimentation.

Frank's Tract Habitat Restoration. Frank's Tract is an island in the Delta which flooded in the 1930s and has never been reclaimed for agricultural production. It occupies a key location in the transition zone between brackish and freshwater habitats. Critically important habitats for aquatic species can be recreated at this site without impacting agricultural land.

A feasibility study for a pilot project to restore Frank's Tract was previously funded in 1998. That study proposed the construction of 4 mid-size channel islands totaling 45 acres. Clean dredge material would be used to increase the bottom elevation at selected locations to approximately 4-6 feet in depth. The pilot project would be monitored to evaluate the benefit for native fish species and potential colonization by non-native invasive plant species.

The approach is to fund efforts to design and construct habitat components that will make Frank's Tract and integral component of the San Joaquin River corridor connecting the western Delta with the lower San Joaquin River.

CALFED will evaluate proposed projects using the following types of criteria:
- Provide for the beneficial reuse of dredged materials
- Provide improved tidal perennial aquatic habitat
- Provide fresh emergent wetland habitat

- Provide an opportunity to develop and implement habitat restoration as an adaptive management experiment complete with conceptual models, testable hypotheses, and comprehensive monitoring.

Delta-wide Ecosystem Restoration/Levees Bundle

Evaluate the Need to Screen Small Diversions in the Delta. There are a large number of relatively small diversions diverting water throughout the Delta. (Note: Small unscreened diversions are also addressed in the Lower San Joaquin River and South Delta Region and the Suisun Marsh and West Delta bundles.) These smaller diversions have the potential to entrain juvenile fish, but there is relatively little data that can be used to identify where the biological benefits would be of the greatest benefit in a program to screen smaller diversions. Evaluations of alternative methods of preventing entrainment at larger diversions have not identified any effective solutions other than positive barrier fish screens. However, when evaluating screening at smaller diversions less that 25 cfs, there may be other techniques for preventing entrainment that could be cost effective in some situations.

Unlike the riverine environment where unscreened diversions may affect a large portion of fish populations, the benefits of screening small diversions throughout the Delta is unknown. An evaluation should be undertaken to identify diversion effects on species and locations in the Delta where screening small diversions is a high priority.

Two general topics are recommended for evaluation: to synthesize existing information on entrainment in the Delta at small diversions and to evaluate entrainment effects at actual diversions if willing landowners can be identified.

The approach is to determine the biological benefits of screening small diversions in a tidal environment and the technical feasibility of doing so. CALFED will evaluate proposed projects using the following types of criteria:

- Contribute to better understanding of the ecological uncertainty related to small unscreened diversions throughout the Delta
- Consolidate existing information regarding the loss of native fish in small unscreened diversions
- Consolidate existing information regarding methods or techniques to install and operate screens on small diversions throughout the Delta.

Non-native Invasive Species Management. The Bay-Delta ecosystem has been characterized as having more non-native invasive species (NIS) than any other system of its kind in the world. The impacts of NIS are a major cause of ecosystem decay. Sources of NIS include ballast water, imported baits, accidental transport, exotic pets and deliberate and illegal introductions.

CALFED has prepared a draft management and prevention strategy to attempt to address NIS present in the system and to minimize future introductions. The early goal of the program is to

offer strategies and to conduct pilot or demonstration projects that will inform the long-term program.

The approach is to clarify the extent to which non-native species may preclude opportunities to reach ecosystem restoration goals and objectives.

CALFED will evaluate proposed projects using the following types of criteria:

- Prevent of significantly reduces additional introductions of non-native species
- Develop better understanding of how non-native species affect ecological processes and biological interactions
- Develop effective control and eradication programs
- Establish habitat conditions that favor native species

Total Organic Carbon Evaluation. Rivers, wetlands, and agricultural operations are major sources of organic carbon to the Bay-Delta system. Carbon is an essential nutrient supporting the aquatic foodweb. However, high concentrations of organic material in water exported from the Delta is the source of many public health concerns. Delta waters are used by over 22 million people for drinking water. When treated with disinfectants such as chlorine or ozone, dissolved organic carbon (DOC) and naturally occurring bromine in water can form carcinogenic disinfection by-products.

The Ecosystem Restoration Program has proposed extensive restoration of tidally influenced fresh emergent wetland and other aquatic habitats that will likely increase the quantity of organic carbon present in Delta waters. At present, there is little information available regarding the amount or quantity of organic material delivered by wetland and agricultural sources in the system and the potential effects on either the Delta aquatic foodweb and drinking water treatment.

The approach for evaluating the beneficial and adverse effects of total organic carbon in the Bay-Delta system is to design, fund, and implement a variety of research programs to clarify many of the important ecological and scientific uncertainties linked to this issue.

CALFED will evaluate proposed projects using the following types of criteria:

- Research to estimate how much and what forms of total organic carbon are produced by wetlands.
- Research to estimated how much and what forms of organic carbon originate from agricultural activities
- Research that identifies wetland management strategies to reduce input of organic carbon to the system
- Research to will assess the impact of restored wetlands as they mature.

ERP Levee Relocation, Berms, and Vegetation Management. A major component of the Ecosystem Restoration Program Plan is the re-creation of shallow, tidally influenced aquatic

habitat in the Delta. This restoration objective could be accomplished by purchase and flooding of agricultural land, the deposition of fish or the setting back of levees. The large-scale flooding of agricultural land can cause regional economic and social impacts. The deposition of fill can cause environmental impacts, navigation impacts and impacts to flood management and water transport.

Setting back levees could produce shallow water habitat in the Delta with fewer impacts but it is a concept with considerable technical uncertainty. There is also a liability concern. Even though the existing levees are often characterized as unstable, most have been in place for nearly one hundred years. A new levee will require time to mature before protected landowners gain confidence.

The approach is to conduct the geotechnical and engineering analysis necessary to establish feasibility and estimated costs associated by setting back levees in the Delta.

CALFED will evaluate proposed projects using the following types of criteria:

- Geotechnical studies to identify areas where the underlying land forms can support levee setbacks.
- Technical studies to identify berm structures that can support fresh emergent and riparian vegetation.

In-channel Islands Restoration. In-channel islands are a remnant habitat type critical to fish and plant species in the Delta. Their abundance has been reduced due to dredging and boat wake and wind wave damage. A major portion of the Ecosystem Restoration Program is dedicated to the reservation, restoration and re-creation of this habitat type. This restoration is critical to the recovery of listed plants and may be critical to the recovery Delta native fish species.

The protection and re-establishment of in-channel islands can be accomplished without land use conversion and can provide additional protection to levees where wind fetch is a problem. Small island creation will provide a beneficial reuse option for clean dredged material.

The approach is to better understand the underlying geomorphic, hydrodynamic, or fluvial processes that create or erode channel island and to demonstrate methods by which to protect or enhance existing channel islands.

CALFED will evaluate proposed projects using the following types of criteria:

- Demonstrate or compare the effectiveness of several types of biotechnical approaches for shoreline stabilization and erosion abatement
- Is linked to previously conducted efforts or is a continuation of a successfully implemented project
- Provides a significant level of monitoring comparing natural and manipulated areas
- Will provide the type of information required to improve the longer-term approach to protecting and restoring mid-channel islands and their associated aquatic and terrestrial resources.

Key Acquisition Areas For Conservation Of Special Status Plant Species. The location and condition of most special status plant species in the Bay-Delta system is poorly understood. Resource agencies have not been able to dedicate staff to conduct comprehensive reconnaissance level surveys. The basic information is critical to a strategic acquisition program that will have to focus on essential locations and minimal disruption to existing land uses. This survey will aid in the identification of key ecological attributes necessary for the propagation and expansion of rare plant species and plant communities. This project will rely on agency staff and consultants with appropriate expertise.

The approach is to design, fund and conduct the appropriate level of field survey to identify critical areas for acquisition and protection.

CALFED will evaluate proposed projects using the following types of criteria:

- Projects that continue or build from previously funded efforts
- Projects that will conserve special status plant species and which will provide transitional habitat corridors.

Propagation Techniques and Restoration Protocols of Rare Plants. Disruption of natural ecological processes make it difficult or unlikely that rare plants will be able to repopulate the Bay-Delta system. Changes in hydrologic regime, bank protection which prevents erosion and insolation of remnant populations substantially impact natural reproduction. The propagation of special status plants is not a mature science. The results of this program would provide the scientific foundation for sound planning for the reestablishment of plant species of concern and a diverse native plant community. Special emphasis will be placed on the protection of genetic integrity for these rare and unique plants. The project will rely heavily on consultant expertise.

The approach is to design, fund and implement research in techniques to propagate rare plants and to identify measures or protocols to establish naturally self-sustaining populations.

CALFED will evaluate proposed projects using the following types of criteria:

- Research that identifies habitat requirements of target plant species
- Research that locates potential sites and specific microhabitats for new populations
- Projects that provide careful logistical, historical, biological and physical reintroduction criteria
- Projects that identify restoration sites on publicly held lands.

Sacramento River, San Joaquin River, and Tributaries Bundle

Sacramento River Meander Corridor Studies and Implementation. River meander is an essential ecological process. The extent to which a river can meander is a key indicator of ecological health. The Upper Sacramento River Advisory Council has sponsored extensive study and modeling of the Sacramento River from Red Bluff to Chico Landing (the unleveed portion

of the river) for 15 years. They have identified about 30,000 acres of private land which could be affected by the natural, long-term meander of the Sacramento River. These lands are proposed for protection by means of easements or direct fee acquisition. Many of the areas will require initial re-vegetation with native plant species.

The approach is to fully coordinate research and acquisition activities with the efforts of the Sacramento River Advisory Council.

CALFED will evaluate proposed projects using the following types of criteria:

- Recommendations of the Sacramento River Advisory Council.

Sediment Management Program. Coarse sediment (gravel and cobble) is an important building block for aquatic and riparian habitat in riverine systems. These sediments help create and maintain spawning habitat for a variety of fish, helps create point bar deposits for colonization by riparian vegetation, and it provides a substrate for the production of aquatic invertebrates and other aquatic foodweb organisms.

Large and small dams trap sediment. Water releases below dams scour sediment and erode downstream areas. Gravel mining in the stream channels and nearby floodplains reduce the overall sediment supply and can produce pits which trap sediment from upstream sources.

General strategies to restore a healthy sediment regime include relocation of in-stream or floodplain gravel extraction activities, the introduction of gravel by trucking, and the re-activation of stream meander processes to provide for the lateral capture of gravel stored in stream banks. Unfortunately, no single strategy fits the numerous streams tributary to the Bay-Delta.

Gravel replenishment is very critical and very expensive. If done correctly, it can rebuild habitats in a sustainable and natural manner. If implemented incorrectly, it can produce only short-term benefits. It can also cause damage to property and the ecosystem or could produce no measurable benefits.

The goals of the sediment management program are to conduct site specific analyses to determine what the sediment budget for a given stream reach should be, to determine the best strategy for restoration, and the most cost method to improve coarse sediment depletions.

The approach is to better understand the fluvial geomorphic processes on individual streams prior to implementing restoration actions.

CALFED will evaluate proposed projects that provide the following:

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Salmon and Steelhead Trout Genetic Management Program. Within the focus area of the Ecosystem Restoration Program there are five natural spawning stocks of chinook salmon. In addition, there are five hatcheries in the Central Valley that propagate salmon from each of the distinct salmon populations. There is only one evolutionarily significant unit (ESU) for steelhead which has spawning populations in numerous tributaries throughout the Central Valley, but, over the years, hatchery managers have imported steelhead stocks from a variety of sources outside the Central Valley in an attempt to increase survival, boost production, and increase angler harvest.

The Ecosystem Restoration Program proposes to facilitate anadromous fish access to important stream reaches within Battle Creek, Butte Creek, Clear Creek, Yuba River, and other locations that have been unavailable to salmon and steelhead for 50 years or more.

With an apparent high level of natural and introduced genetic diversity within the Central Valley, natural recolonization of historic spawning and rearing habitats could lead to further hybridization, introgression, and loss of genetic integrity of small natural populations.
The approach is to design, fund and implement investigations needed to develop or refine elements of a genetic management program building on existing information and programs.

CALFED will evaluate proposed projects using the following types of criteria:

- Establish stock specific guidelines for genetic conservation and management, including guidelines to minimize the effects of hatchery practices.
- Implements a long-term genetic monitoring program.
- Identifies an appropriate "founder" populations to accelerate recolonization efforts
- Prepares and implements guidelines for the operation of weirs and fish ladders to protect genetic diversity and integrity.
- Updates existing extinction models for winter-run chinook salmon and develops similar models for other chinook and steelhead stocks.

Hatchery Operations. Five hatcheries that propagate chinook salmon and steelhead are operated within the Central Valley. They were required as mitigation for the loss of spawning areas that resulted from the construction of dams. These hatcheries serve this narrow purpose well and provide a buffer to maintain viable populations during natural catastrophic events such as drought and adverse ocean conditions.

The hatcheries do not compensate for lost rearing habitat, foodweb production or habitat variability associates with the displacement caused by dams. Hatchery produced fish can compete with naturally spawning fish for food and habitat. In some instances, hatchery fish prey on wild fish. As the Ecosystem Restoration Program move forward and succeeds in restoring naturally spawning populations of chinook salmon and steelhead, potential conflicts with hatchery programs and products will increase.

The approach is to develop an integrated hatchery management strategy that reduces the potential conflict with wild fish, maintains a viable harvest strategy, and optimizes progress toward the goals of self-sustaining populations of wild salmon and steelhead.

CALFED will evaluate proposed projects using the following types of criteria:

- Are supported by the Department of Fish and Game and the U.S. Fish and Wildlife Service
- Bring in outside expertise
- Builds on lessons learned at other salmon and steelhead hatcheries along the Pacific Coast.

Fish Marking And Tagging Programs. Fish marking, tagging, and recovery programs provide important information regarding the age and origin of chinook salmon and steelhead harvested in sport and commercial fisheries. Historically, marking and recovery programs at individual hatcheries and other facilities in the Central Valley were ad hoc and driven by short term needs. Typical research need have included timing of hatchery release, release location, race evaluations and performance, contribution rates to ocean fisheries, and experimental releases to evaluate smolt captures at Chipps Island. All these marking programs have been opportunistic and directed at answering specific questions. The information is used to refine hatchery management practices, release strategies, water management actions, and establish regulatory or compliance measures.

A comprehensive, system-wide program to mark and recovery chinook salmon and steelhead is an essential component of managing and restoring these species. CALFED has recently funded the design of a statistically based marking and recovery program and anticipated the need to provide funding to implement the program.

The approach is to closely coordinate with the Interagency Ecological Program's Salmon and Steelhead Project Work Team's in this issue. In addition, coordination is needed with the Department of Fish and Game and the U.S. Fish and Wildlife Service as they operate the salmon and steelhead hatcheries in the Central Valley.

CALFED will evaluate proposed projects using the following types of criteria:

- Implements previously funded feasibility of design studies

Butte Creek, Clear Creek, Deer Creek, and Tuolumne River Restoration. Numerous actions have been identified for these creeks. In previous years, numerous projects have been implemented. All these creeks support chinook salmon and steelhead are clearly critical habitats for threatened and endangered species.

Butte Creek has been a focal point for early implementation of actions under Category III funding. Substantial progress has been made. All indicators of ecosystem health are moving in a desired direction. There is no suggestion in the project monitoring or at the landscape level monitoring of a need to change restoration direction.

Clear Creek has bee suggested as a demonstration watershed for Stage 1A implementation of the Ecosystem Restoration Program. Flow in lower Clear Creek is controlled by the US Bureau of Reclamation and the creek has active stakeholder and agency watershed groups.

Deer Creek has been suggested as a demonstration watershed for Stage 1A implementation of the Ecosystem Restoration Program. It was proposed because it is one of only three or four streams which support spring-run chinook salmon. Deer Creek has an active local watershed organization. Deer Creek is relatively undamaged and restoration of ecological processes and functions are feasible. The principal focus of restoration on Deer Creek is the reintroduction of floodplain processes. The potential options for achieving this objective range from levee set-backs and new levee construction to flood easements and channel reconfiguration.

The Tuolumne River has also been suggested as a demonstration watershed for Stage 1A implementation of the Ecosystem Restoration Program. It was proposed because it has great restoration potential for San Joaquin River fall-run chinook salmon.

The overall approach for these tributaries is to closely coordinate with local watershed groups and interested agencies in developing restoration actions to benefit aquatic and terrestrial resources. Spring-run chinook salmon, San Joaquin fall-run chinook salmon, and steelhead are the primary target species to benefit from restoration actions.

CALFED will evaluate proposed projects using the following types of criteria:

- Local watershed organization support
- Contributes to resolving scientific uncertainties regarding watershed management and species restoration
- Implements actions identified in previously funded feasibility studies
- Contributes to the recovery of listed species.

Bundled Stage 1A Actions (Ecosystem Program) Symbol Key: ● = strong linkage, ■ = linked, □ = weak linkage	Linkages of Ecosystem Restoration Elements in Stage 1A Bundles											
	Watershed Management	Levee System Reliability	Water Transfers	Water Quality	MSCS	Scientific Review	Queued Project	Other Agency Link	EWA	Adaptive Management	Comprehensive Monitoring	
Lower San Joaquin River and South Delta Region Bundle												
San Joaquin River Floodplain Corridor		●			●	●	●			●	●	
Creation and Evaluation of the Ecological Benefits of Fresh Emergent Wetland Habitat in the South Delta				■	●	●				●	●	
Ecosystem Restoration Program Levee Setback Feasibility Study		●			●							
Evaluate the Need to Screen Small Diversions in the Delta					●	●	■	■		●	●	
Lower Sacramento River, Yolo Bypass, and North Delta Bundle												
Restore Tidal Habitats along Georgiana Slough				□	●	●		■		●	●	
Integrate Ecosystem and Flood Control Improvements in the Lower Mokelumne River		●		□	●	●		■		●	●	
Provide Needs and Opportunities Analysis for Improving Ecosystem Restoration and Flood Bypass Habitat in the Yolo Bypass Area												
Cache Creek Mercury Source Control	●			●		●		●		●	●	
Suisun Marsh and West Delta Bundle												

Bundled Stage 1A Actions (Ecosystem Program) Symbol Key: ● = strong linkage, ■ = linked, □ = weak linkage	Linkages of Ecosystem Restoration Elements in Stage 1A Bundles											
	Watershed Management	Levee System Reliability	Water Transfers	Water Quality	MSCS	Scientific Review	Queued Project	Other Agency Link	EWA	Adaptive Management	Comprehensive Monitoring	
Implement Suisun Marsh Diversion Screening Program				●	●		●					
Evaluate and Restore Tidal Wetland in Suisun Marsh and Van Sickle Island				●	●							
Frank's Tract Habitat Restoration				●	●		●					
Delta-wide Ecosystem Restoration/Levees Bundle												
Evaluate the Need to Screen Small Delta Diversions					●	●						
Non-native Invasive Species						●					●	
Total Organic Carbon Evaluation						●		●			●	
ERP Levee Relocation, Berm, and Vegetation Management		●			●	●				●	●	
In-channel Islands Restoration					●						●	
Key Acquisition Areas for Conservation of Special Status Plant Species		●			●					●		
Develop Propagation Techniques to Conserve Special Status Plant Species		●			●					●		

Sacramento River, San Joaquin River, and Tributaries Bundle												
Sacramento River Meander Corridor Studies and Implementation					●	●	●		●			
Sediment Management Program						●			●	●		
Salmon and Steelhead Trout Genetic Management Plan					●	●	●		●	●		
Hatchery Operations					●	●			●	●		
Fish Marking and Tagging Program					●	●		●	●	●	●	
Butte Creek, Clear Creek, Deer Creek, and Tuolumne River Restoration	●			●	●	●	●	●		●	●	
Symbol Key: ● = strong linkage, ■ = linked, □ = weak linkage												